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ICE AND FROST

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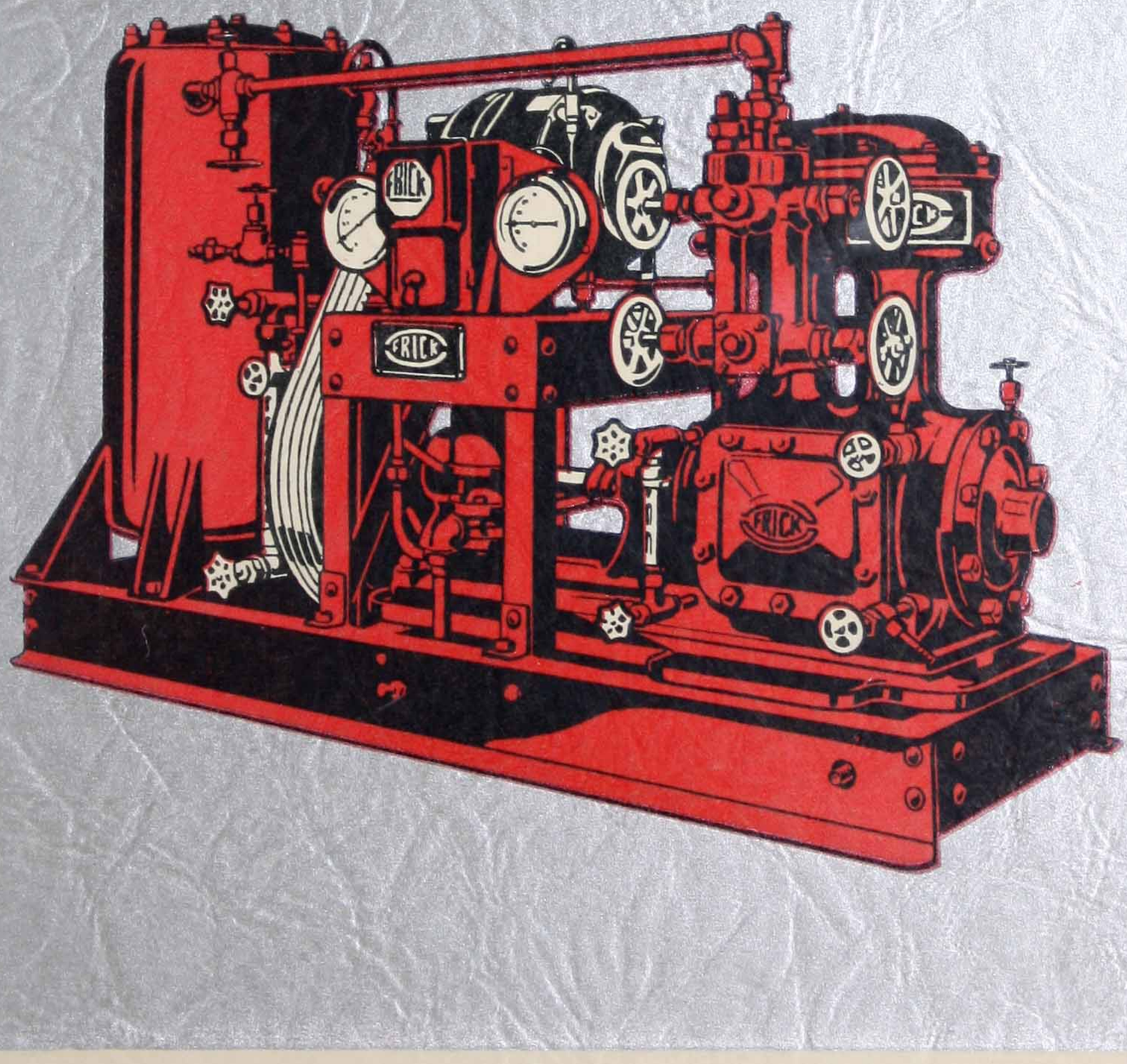
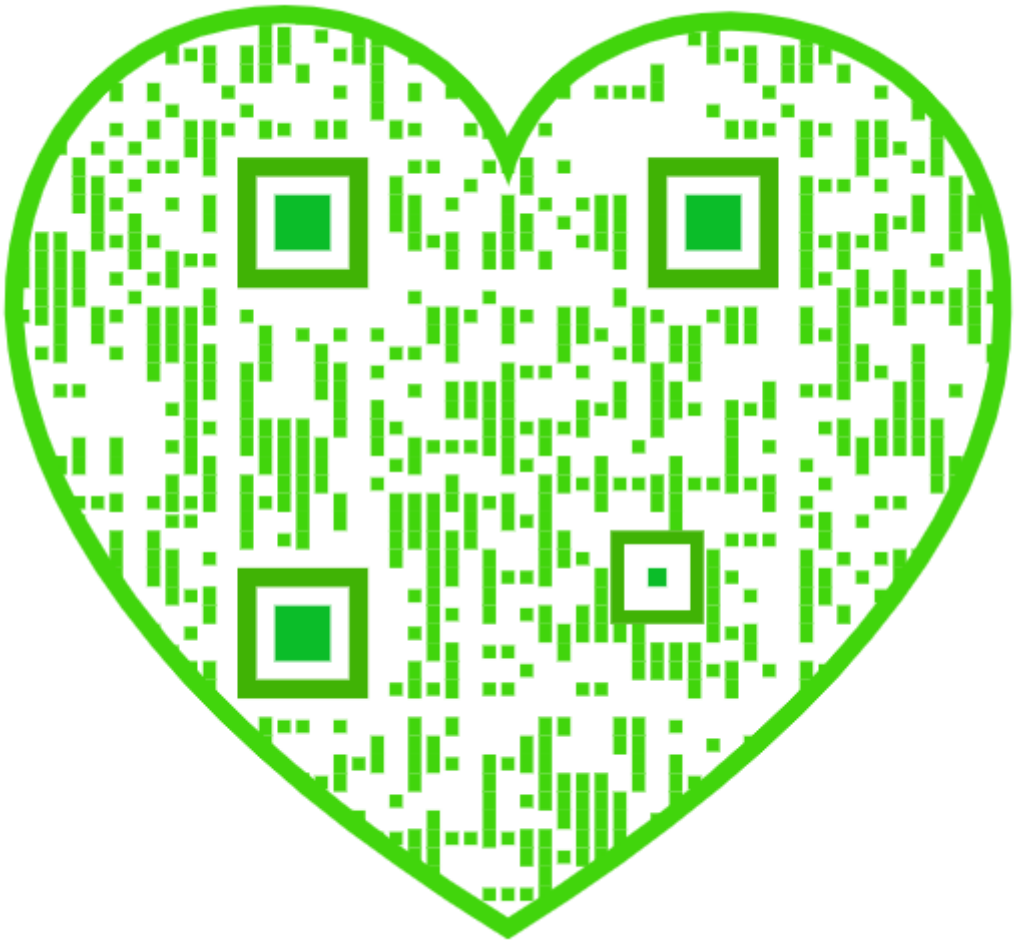


Bulletin
104-H

Combined Ammonia
Refrigerating Units



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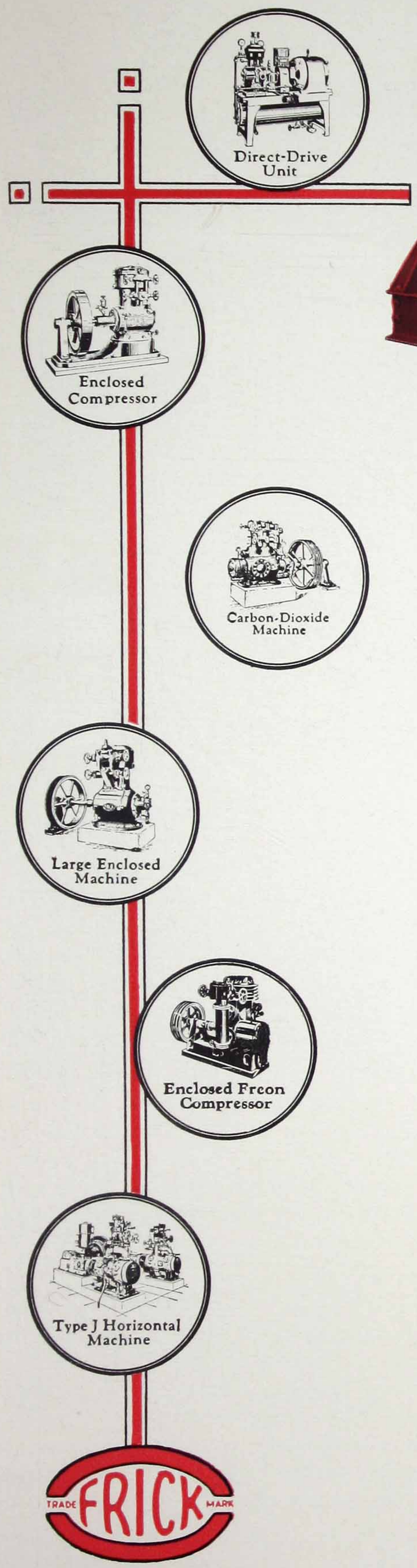

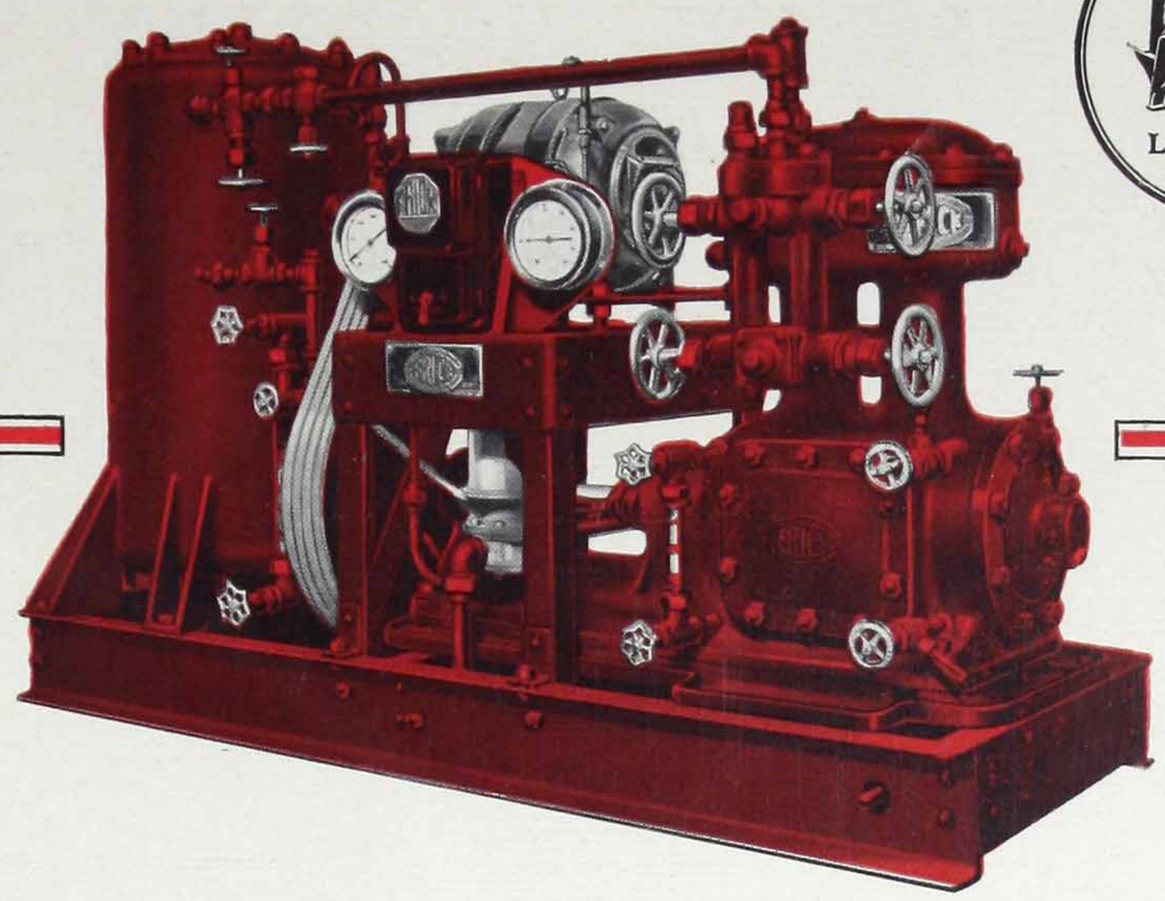

Combined Ammonia Refrigerating Units

Leading Features

Ammonia has been considered the standard refrigerant for more than 50 years, and remains today the best all 'round medium for commercial cooling systems in all except the smallest sizes. An ammonia machine operates with greater economy, delivering more "cold" for the same money, than any other type in general use.

The tens of thousands of Frick ammonia machines operating with perfect satisfaction in hotels, restaurants, hospitals, aboard ship and in similar places where people gather, are the surest evidence of the safety and reliability of this class of equipment.

The Units described in this Bulletin include in one assembly the entire high-pressure part of the refrigerating system—compressor, motor, starter and drive, condenser-receiver, water regulator, gauges, safety devices, etc. —all mounted on a substantial steel base. The machine is completely built and tested at the factory, and is ready for service when delivered. It can be taken through any ordinary doorway, and requires no special foundations: the Unit is as easily moved as a show case or refrigerator—an important feature to the user who rents his place.

These Belt-driven Ammonia Units are furnished in four sizes, all of the same superior design. The compressor used is the regular Frick vertical enclosed type, with single-acting cylinders—the most efficient type known. Control is full automatic or by hand, as desired.

In the following pages are shown some of the scores of uses to which these Refrigerating Units can be profitably applied.

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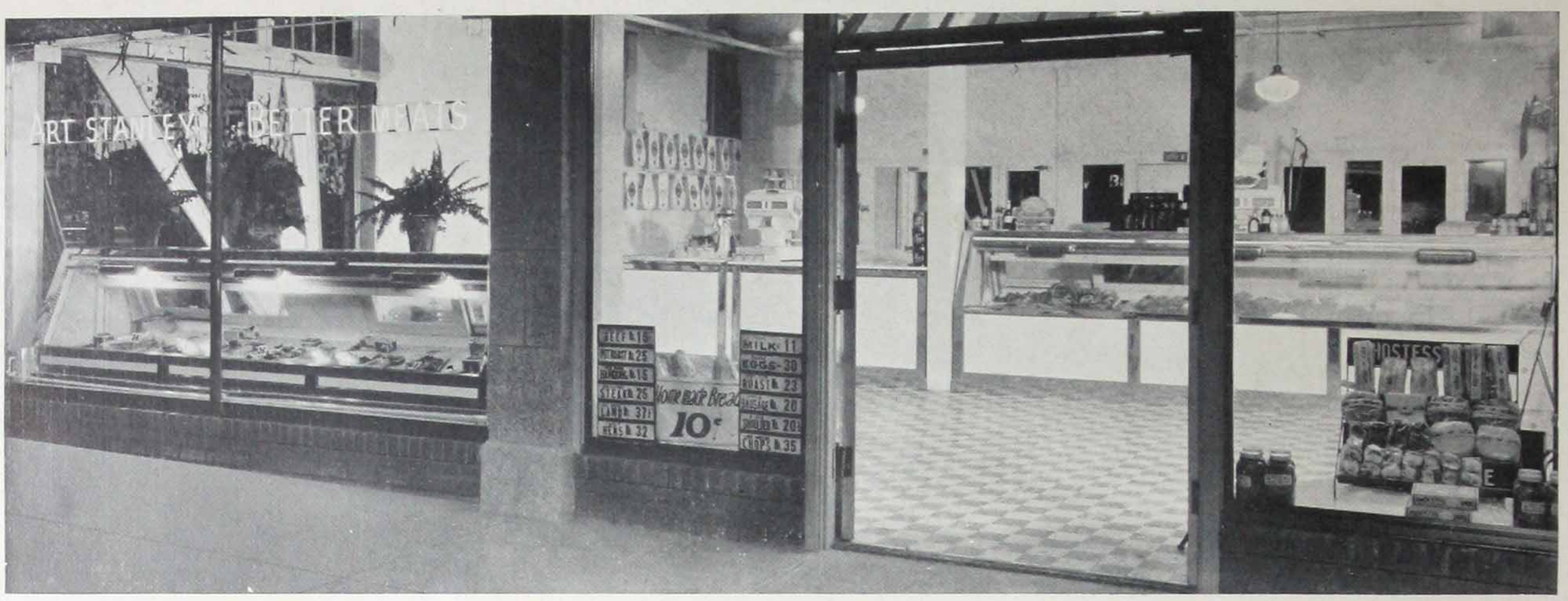
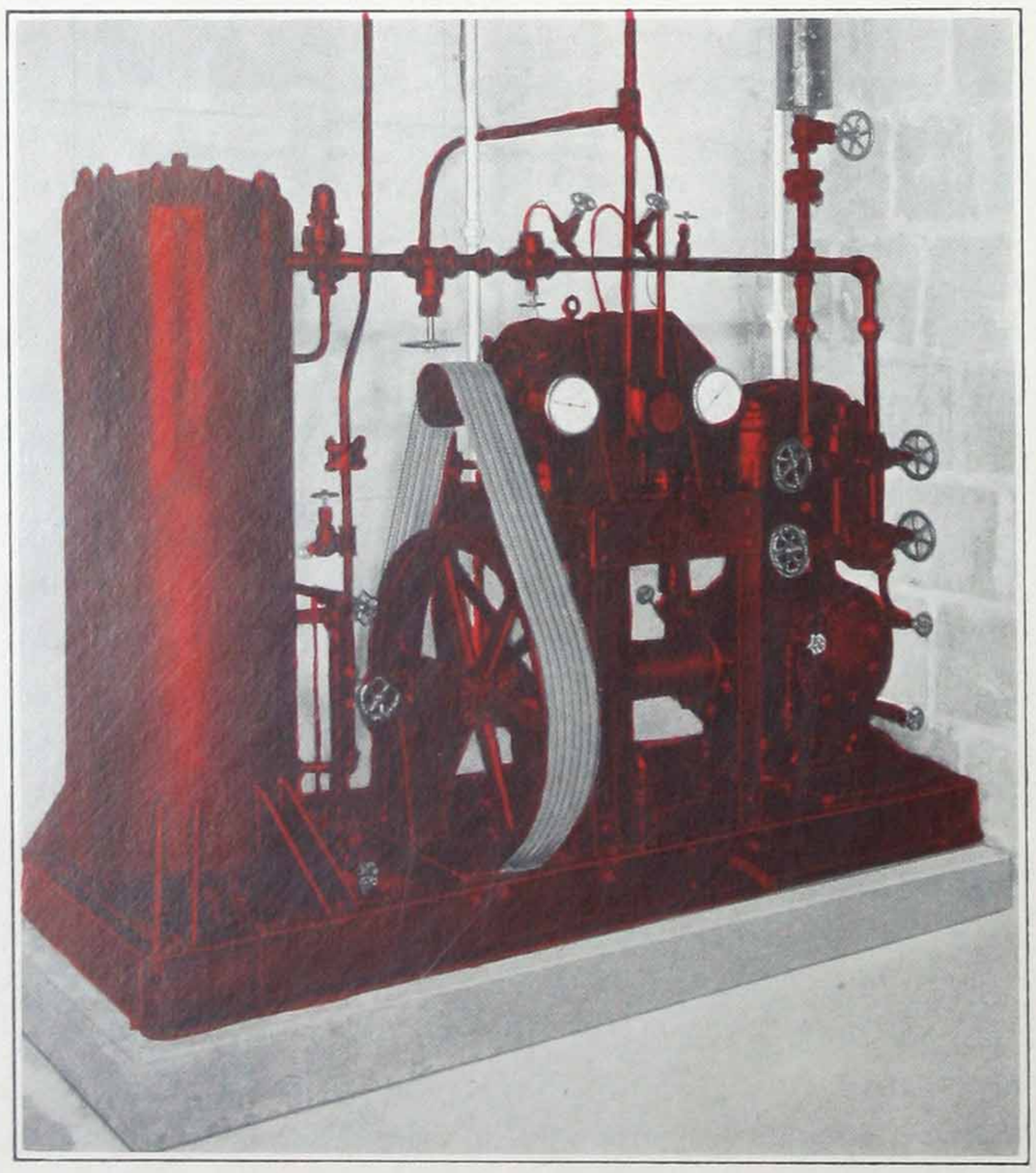
Frick Bulletin No. 104-H

ICE AND FROST



A 3 by 3 Double-cylinder Frick Unit Cools Three Display Cases and a Walk-in Box at Art Stanley's Market, Denver, Colo.

Markets, Grocery & Other Food Stores



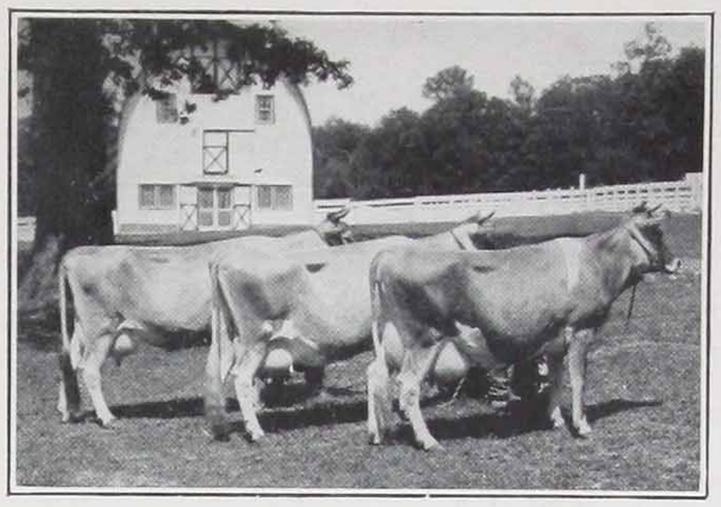
One of Twenty Frick Ammonia Units in Operation at the Great Niagara Frontier Food Terminal, Buffalo, N. Y.

Twenty or twenty-five years ago, when Frick ammonia machines first began to be installed in stores handling meat, fish, fruits, vegetables, and ready-to-serve foods, the full advantages of adequate refrigeration were but little understood. Today the value of superlatively fresh products, attractive display and economy in maintaining stocks are fully recognized by all retailers, with the result that refrigerated cases and walk-in boxes are to be found in crossroad stores as well as in city markets.

For this kind of service the Frick Ammonia Unit has every qualification that could be desired: quiet, automatic operation; economy in power, water and attention required; life-long service and dependability; pleasing appearance, extra capacity, and other features too numerous to mention.

Cooling coils are furnished to suit the exact needs of the owner, with full regard for such items as uniform temperatures to be held, proper humidities, defrosting, etc. An ammonia system, with the aid of modern automatic control, can now be made to take care of a much larger load than is usually possible with hand operation: improved coils and better methods of ammonia feed have also greatly increased the efficiency of the cooling surface.

The Dairy Barns, Showing the Walkway Leading to the Milking Parlor, on the Farm of Col. T. L. Huston at Butler Island, near Darien, Ga. A Frick Unit Serves Both to Cool the Milk and Make Ice for Shipping It



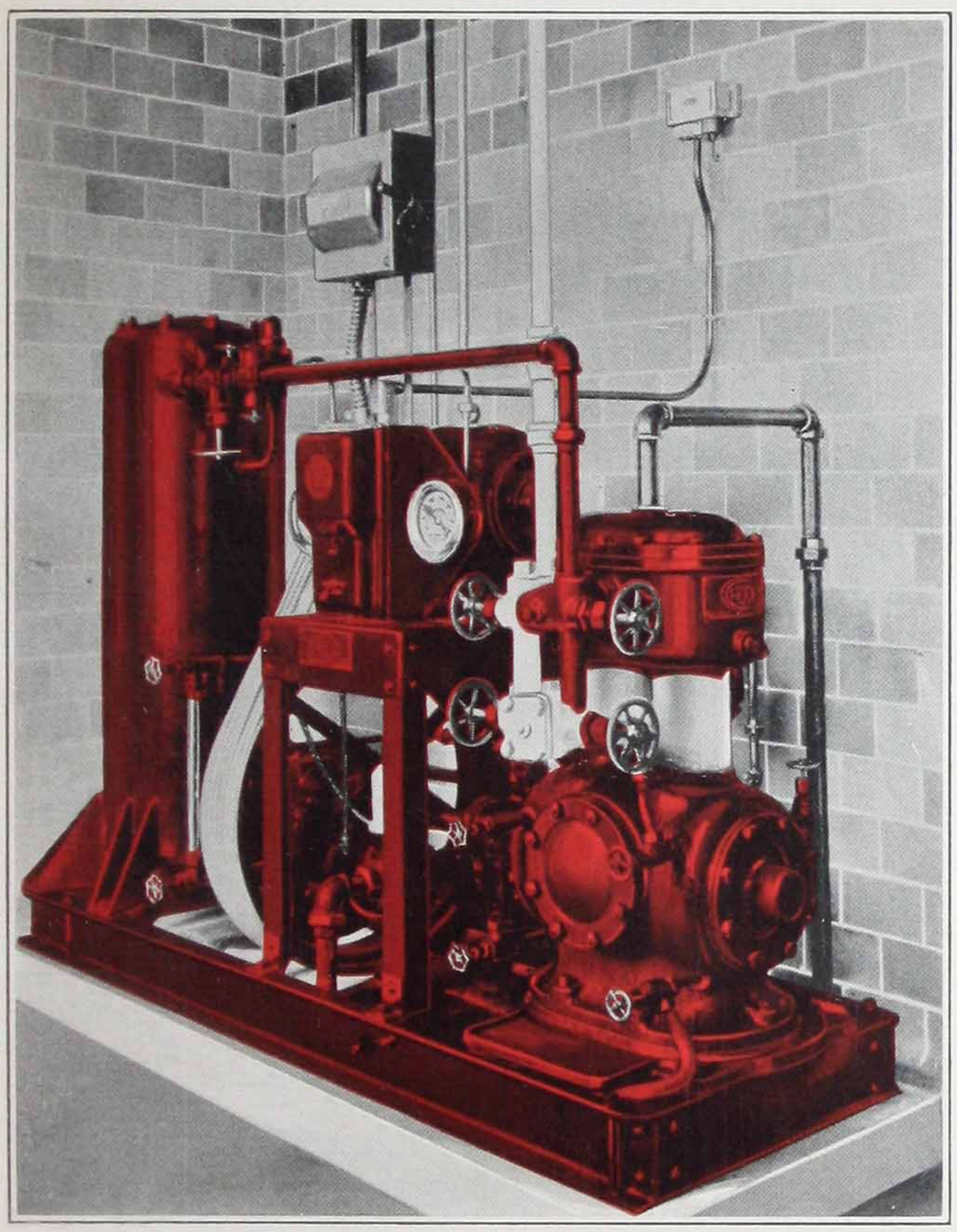
Three of the Famous Matrons at the Green Hill Farms, Mt. Juliet, Tenn., Where an Average Bacteria Count of Less than 1,000 is Maintained with the Aid of a Frick Ammonia Unit

Dairies and Creameries

Frick ammonia refrigeration has been a favorite in the milk trade for more than half a century, and is used throughout this great industry from dairy farms to city milk plants, not to mention the ice cream plants, butter and cheese plants, etc.

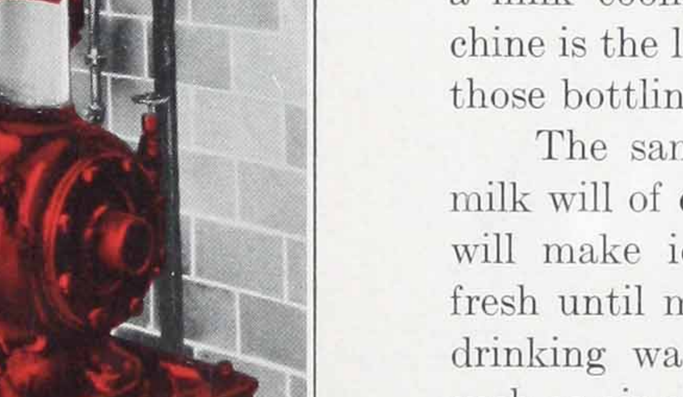
While the smaller dairy farms generally employ low pressure refrigerating machines connected to a milk cooling cabinet, a combined ammonia machine is the logical choice for larger farms, especially those bottling the milk from their own herds.

The same machine in addition to cooling the milk will of course refrigerate the storage room, and will make ice, keep fruits, vegetables and meats fresh until marketed, freeze ice cream, furnish cold drinking water, or perform other cooling services such as air conditioning or refrigerating a box in the dwelling, as may be required.

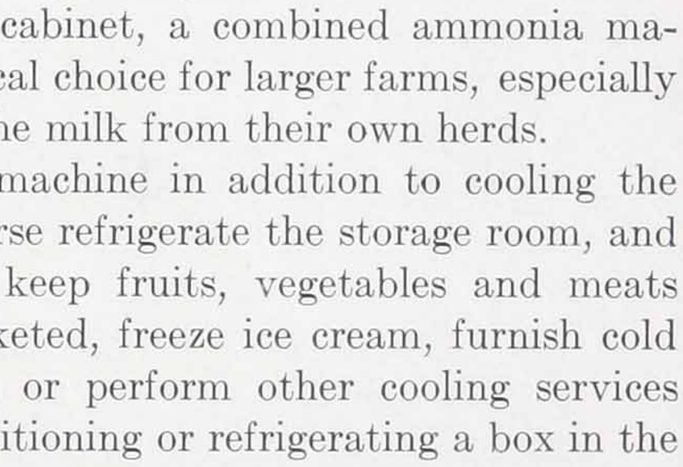


5-in. by 5-in. Machine Cooling Milk at a Dairy Plant Near Carlisle, Penna.

Exterior of the Storage, Ice-Making Tank and Machine at the Rock Creek Dairy



Milk Storage Room, Showing Frosted Pipes at the Rock Creek Dairy, Greensboro, N. C.



Cold Storage Room and Machine at The Miller Dairy Farm, Near Richmond, Va.

Architectural Work & Air Conditioning

Hotels, clubs, hospitals, stores, theatres, residences, and industrial plants of many kinds use Frick refrigeration for one or more of the following services:

Air conditioning

Cooling any number of refrigerators, boxes, and display cases

Furnishing cold drinking water to fountain and pitcher outlets

Freezing ice cream and other frozen desserts

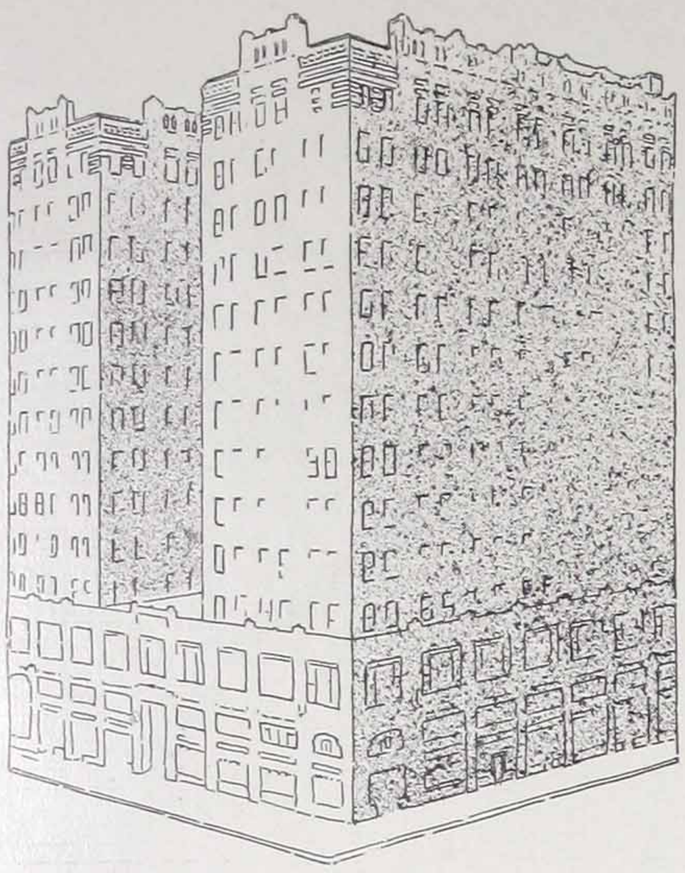
Cooling beverages for soda fountains and bars

Making ice, in any of its forms

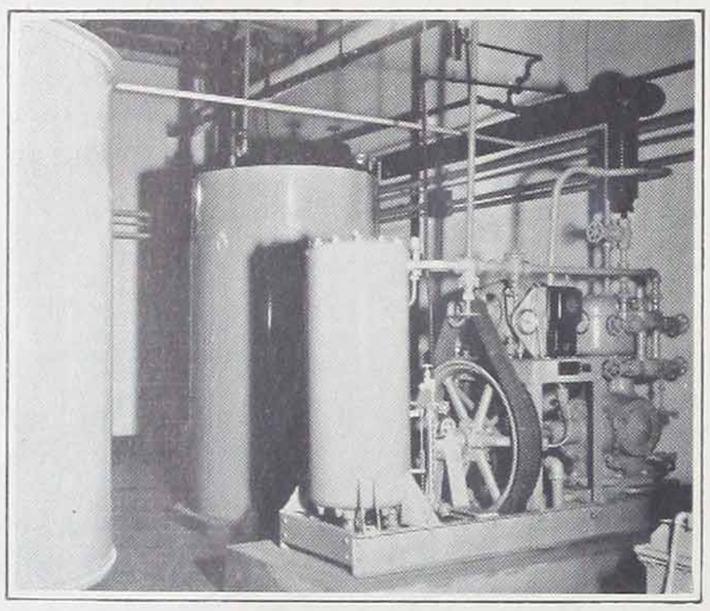
Doing special work, such as in fur storages, flower and confectionery shops, dental offices, laboratories, process work, etc.

Are you taking full advantage of all these services which apply to the buildings you occupy or manage?

The public has come to expect the greater comfort, convenience, healthfulness, and attractiveness made possible only through the aid of adequate refrigeration; figures prove that it pays to meet present day demands in this respect.

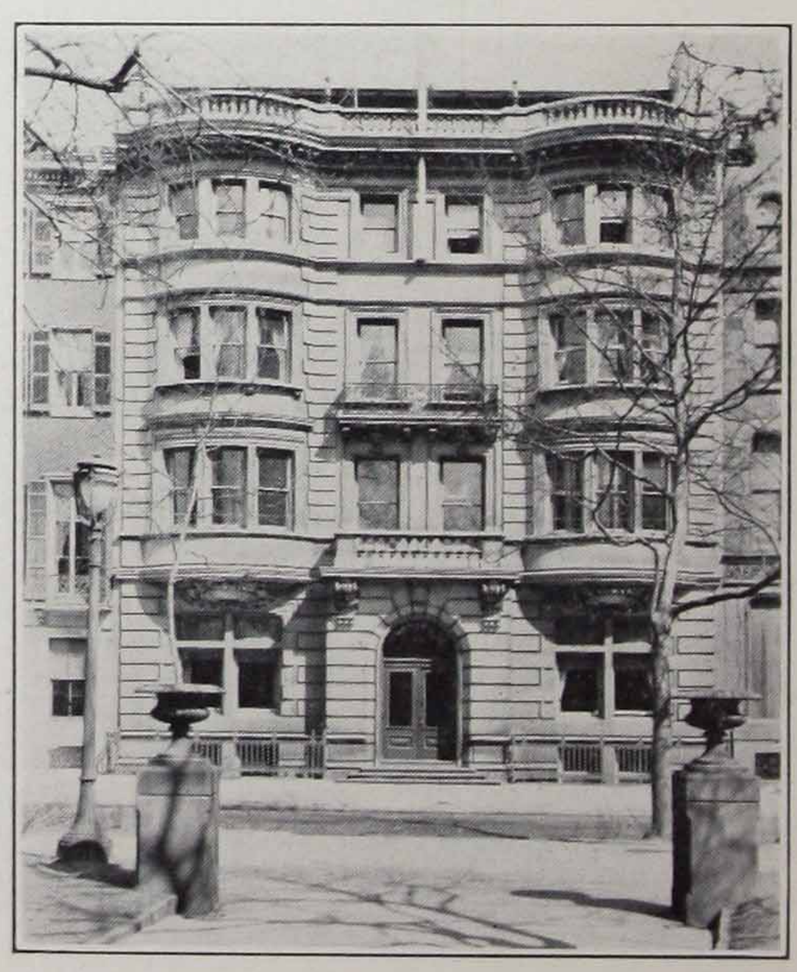


The Philcade Building at Tulsa, Okla. Uses the Frick Ammonia Unit Illustrated below for Cooling Drinking Water



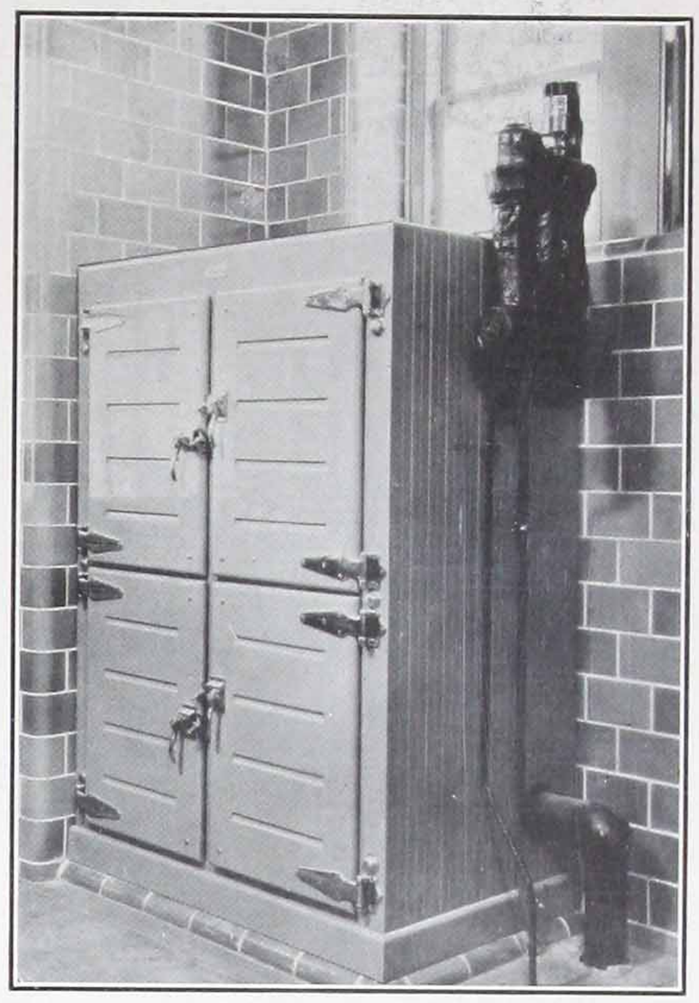
The Harrisburger Hotel, at Harrisburg, Pa., is one of many Hotels, Theatres, Restaurants, Stores and Industrial Plants Using Refrigeration for Food Service, Freezing Ice and Ice Cream, Cooling Drinking Water and Conditioning Air. Photo shows the Barber Shop at The Harrisburger, Air Conditioned with the Aid of a Frick Combined Ammonia Refrigerating Unit

At the Rittenhouse Square Club, in Philadelphia, a Frick Ammonia Unit makes Ice and Cools Several Refrigerators for Food Service



There's a 3 by 3 Frick Unit in the Vance Hotel, at Statesville, N. C., Where the "Great Lakes to Florida" Highway Crosses that "From the Mountains to the Sea"

The City Memorial is One of Two Fine Hospitals in Winston-Salem, N. C., Using Frick Refrigeration. Here a 5 by 5 Machine Holds 7 Boxes at 38° F. and Makes 2 Tons of Ice

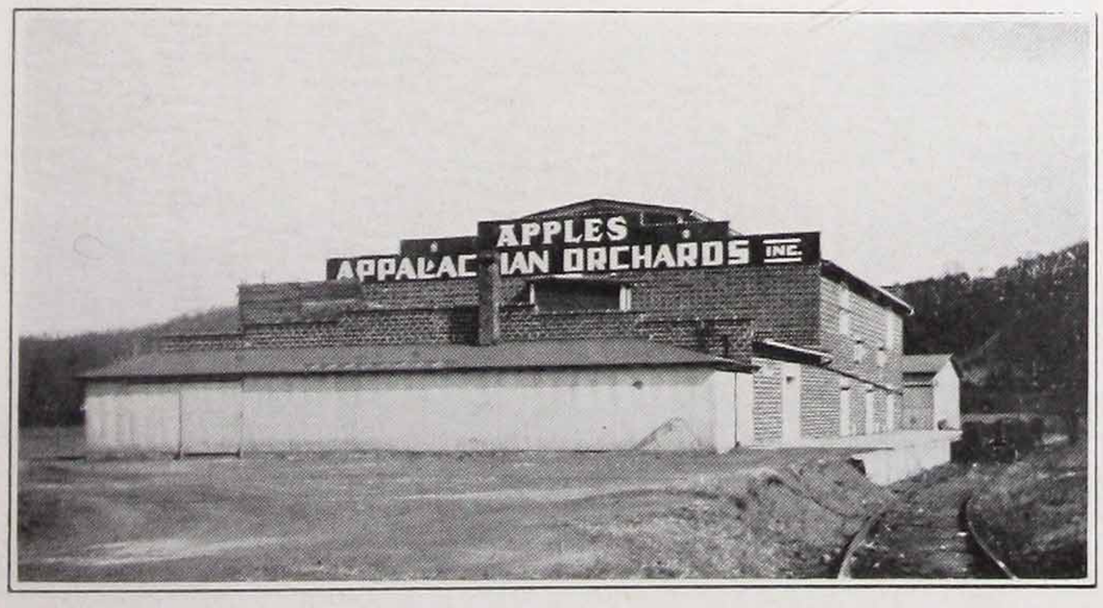


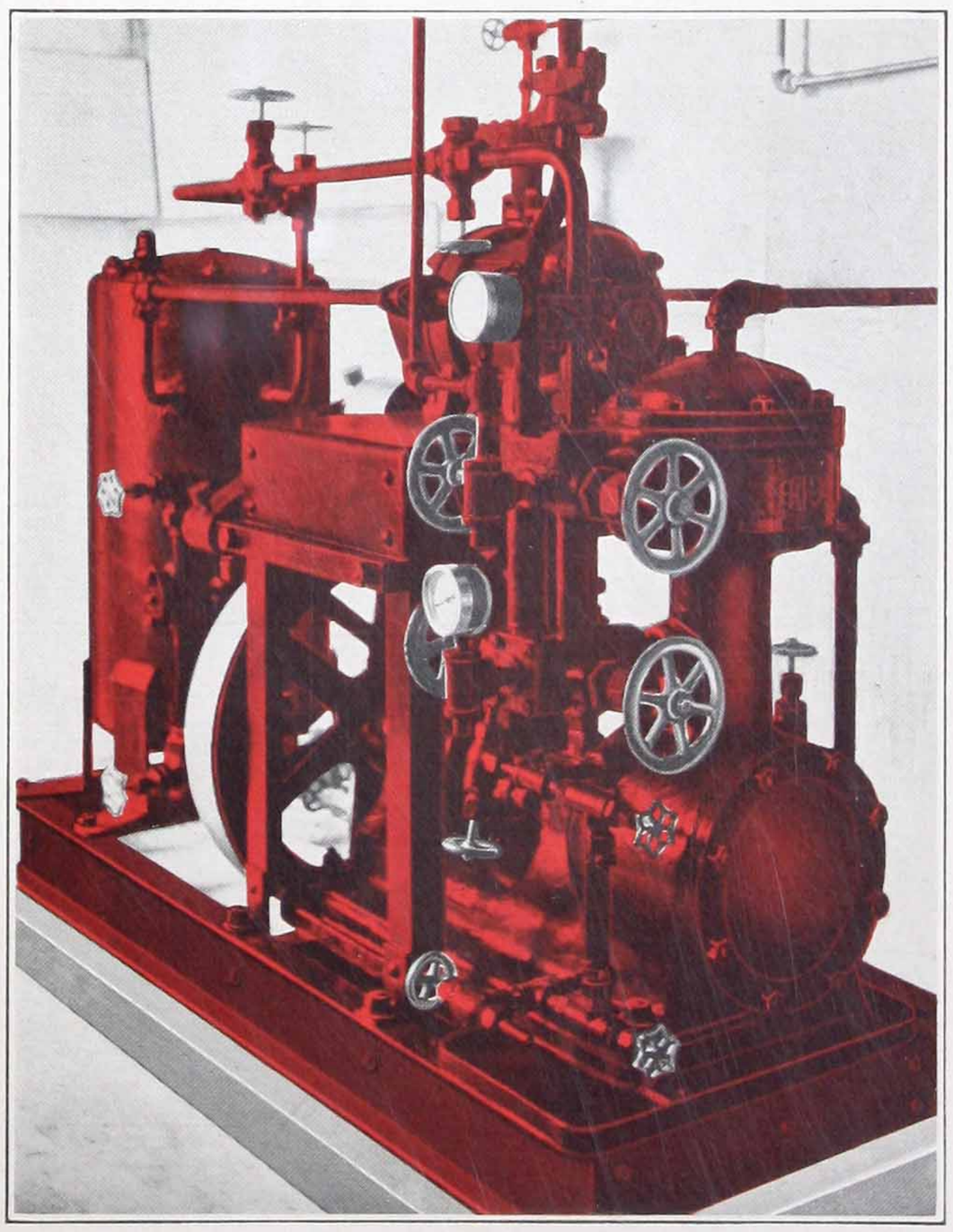
Chef's Refrigerator at Carlisle, Penna. Hospital, Where a Frick Ammonia Unit Also Cools Several Walk-in Boxes

The safety of a Frick ammonia system is shown by the fact that there are thousands of installations of these machines in hospitals, hotels, restaurants, club houses and in other places where large numbers of people make safety of primary importance. The extremely rigid pressure tests, repeated inspections and trial runs, to which Frick machines are subjected, have aided in developing them to their present state of absolute safety and dependability when given reasonable care.

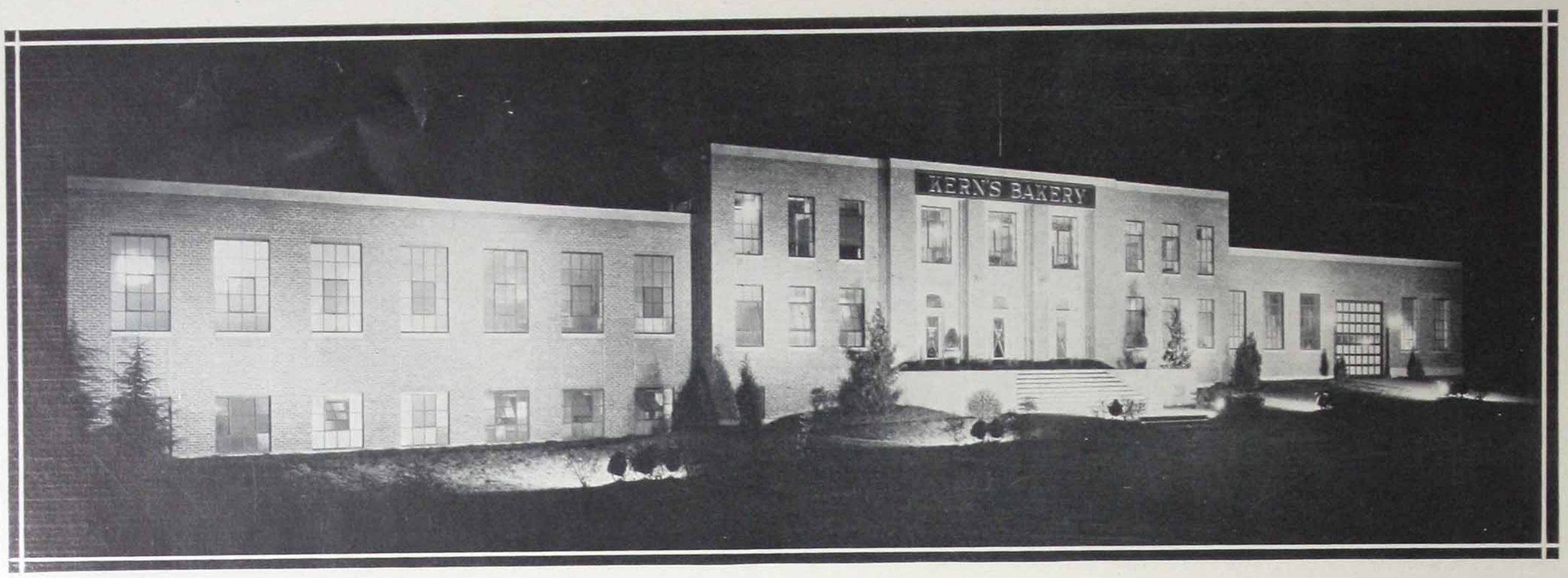
Frick Engineers will gladly assist you in solving your special cooling problems and in adapting modern refrigeration to your wider needs. Although few people might realize it, refrigerating plants have been improved in the last 20 years almost as much as have automobiles; plants that have been operating for a considerable time can therefore be modernized, to great advantage in both effectiveness and saving in power.

Farmers are Installing Frick Units in Privately Owned Apple Storages like this one at Paw Paw, W. Va., where the Machine Paid for Itself the First Year



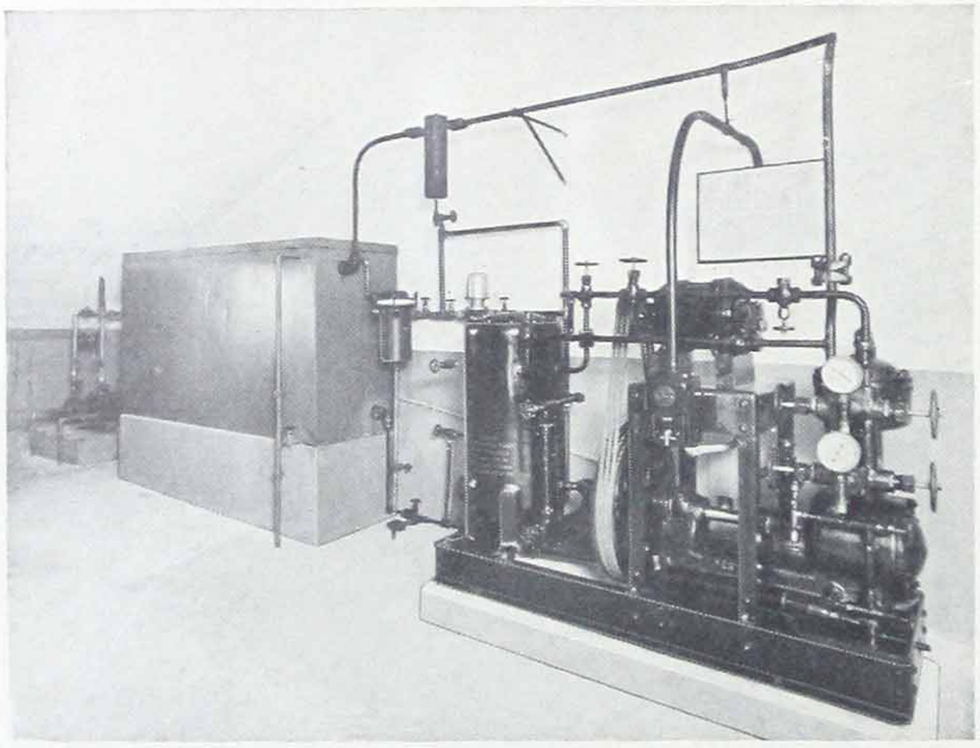


One-Cylinder Frick Unit installed in the Reading, Penna., High School, where it Provides Refrigeration for Food Service in the Cafeteria



Kern's Bakery at Knoxville, Tenn., Uses Two Frick Combined Ammonia Units for Storing Ingredients and Cooling Water to 33 deg. for Making Doughs, Cooling the Mixers, and Controlling Humidity in the Dough Room

Water Cooling Systems



The Foreign Office Building at Rio de Janeiro, Brazil, Uses This Frick Plant for Cooling Drinking Water

Bakeries, creameries, bottling plants and certain chemical works are among the many establishments that make better profits by having available plenty of cold water, the year 'round. Refrigeration also serves in other useful ways such as furnishing cold drinking water, cooling cold storage boxes, and doing air conditioning, in these plants.

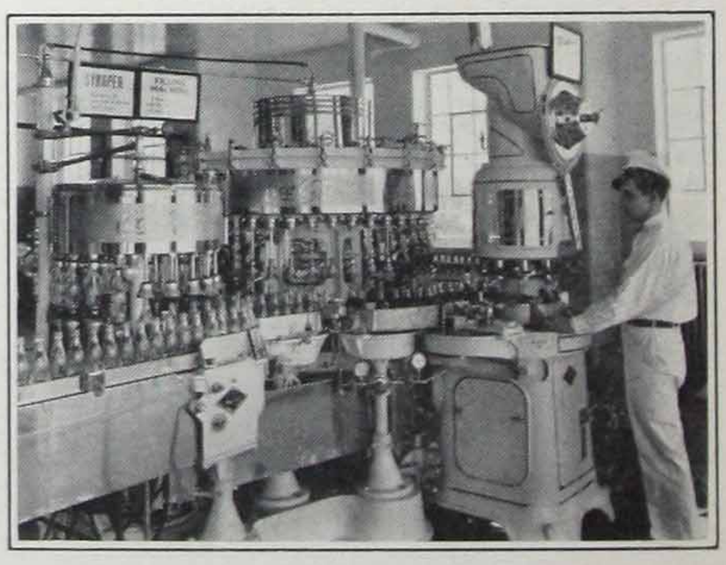
Not only are Frick ammonia units perfectly adapted to these requirements, but Frick coolers of special design have been developed to meet the exact needs of each class of service. For the rapid and economical cooling of water the patented zig-zag or "instant" water cooler is recommended.

The advantages of a circulating system of cold drinking water need hardly be stressed, as the owners of office buildings, hotels, hospitals, department stores, restaurants, theaters and industrial plants now recognize how much better people work (and play) when a fountain of cool, fresh water is always close at hand.

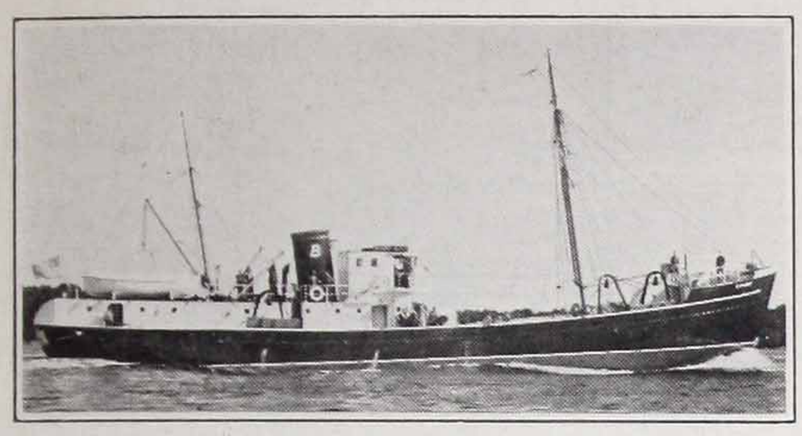
Let us assist you in laying out a water cooling system that will yield a positive financial return.

The Merchants & Mfgrs. Building at Houston is Supplied with Cold Drinking Water by a 3 by 3 Frick Unit

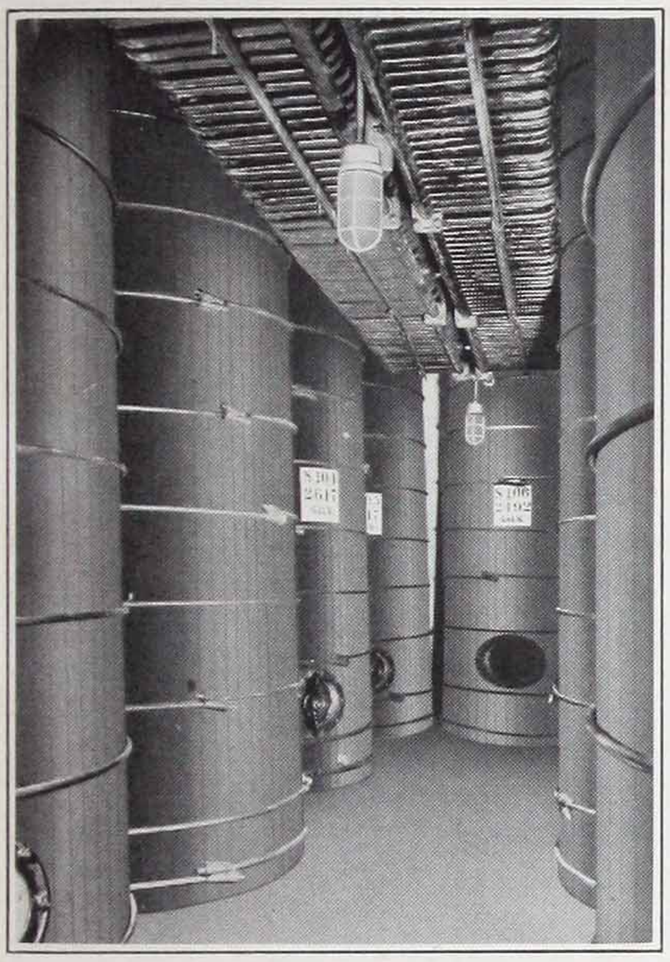
5 by 5 Unit and Instant Water Cooler at the Bacon Bottling Co., Hartford, Conn.



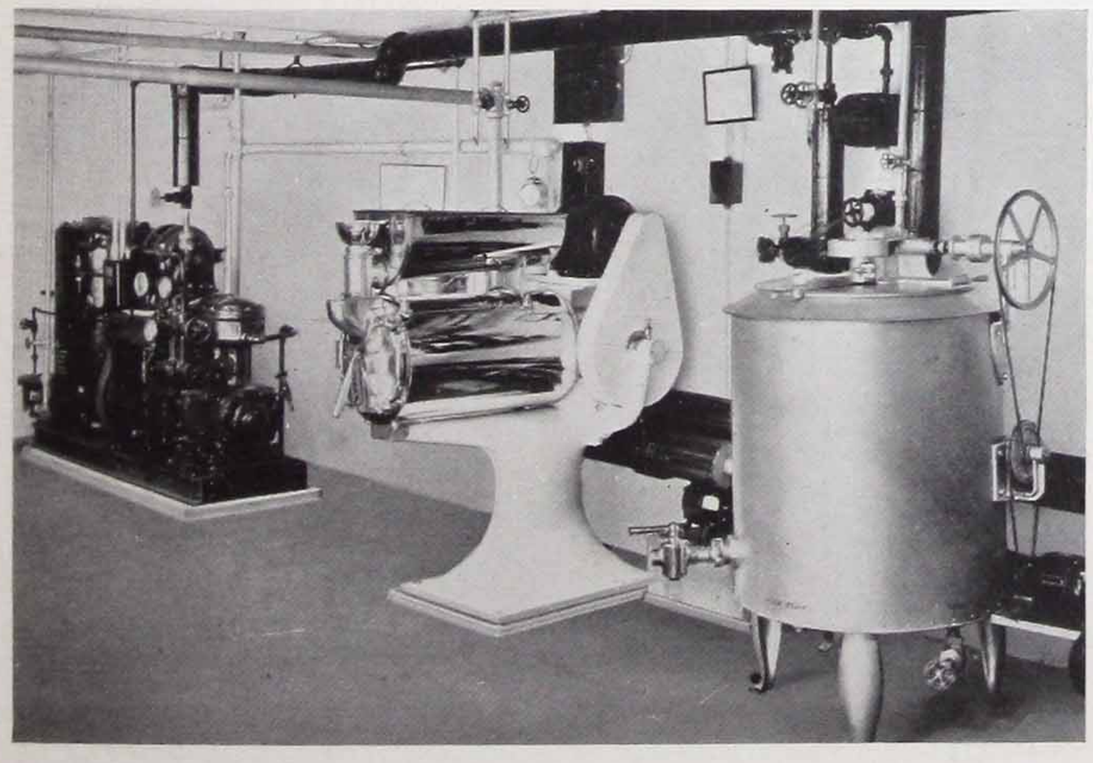
The Coca Cola Bottling Co., at Parkersburg, W. Va., uses a Frick 4 by 4 Unit for Water Cooling



The "Storm" is among the Four Trawlers of the Forty Fathom Fleet which Carry Less Ice and 1/3rd Larger Catch because Equipped with Frick Refrigerating Units



"Virginia Dare" and other Famous Wines are Aged in this Room at the Atlanta Winery of Garrett and Co. A 5 by 5 Frick Unit is Connected to both the Wine Precooler and the Type VW Coils in this Storage



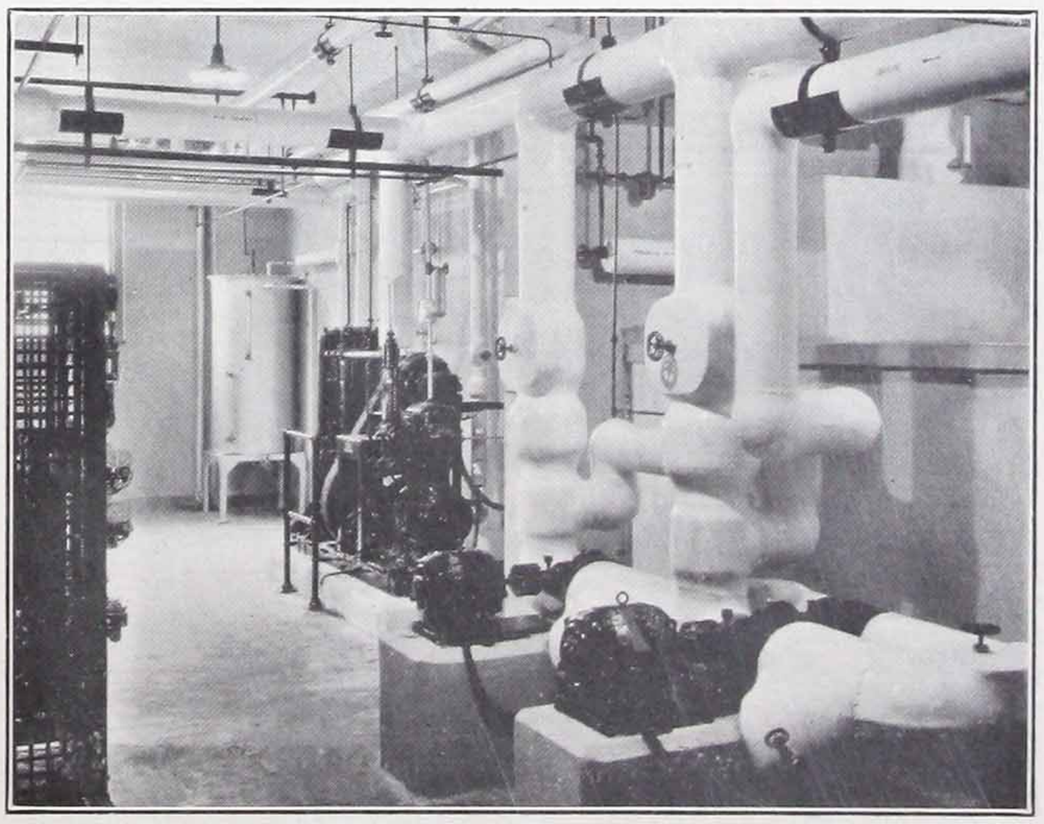
Frick Unit in the Ice Cream Plant of Adolph Bettells at Bridgeport, Conn., Which Includes a Brine Tank, Hardening Room, and 8-Hole Ice Cream Cabinet

Various Other Uses

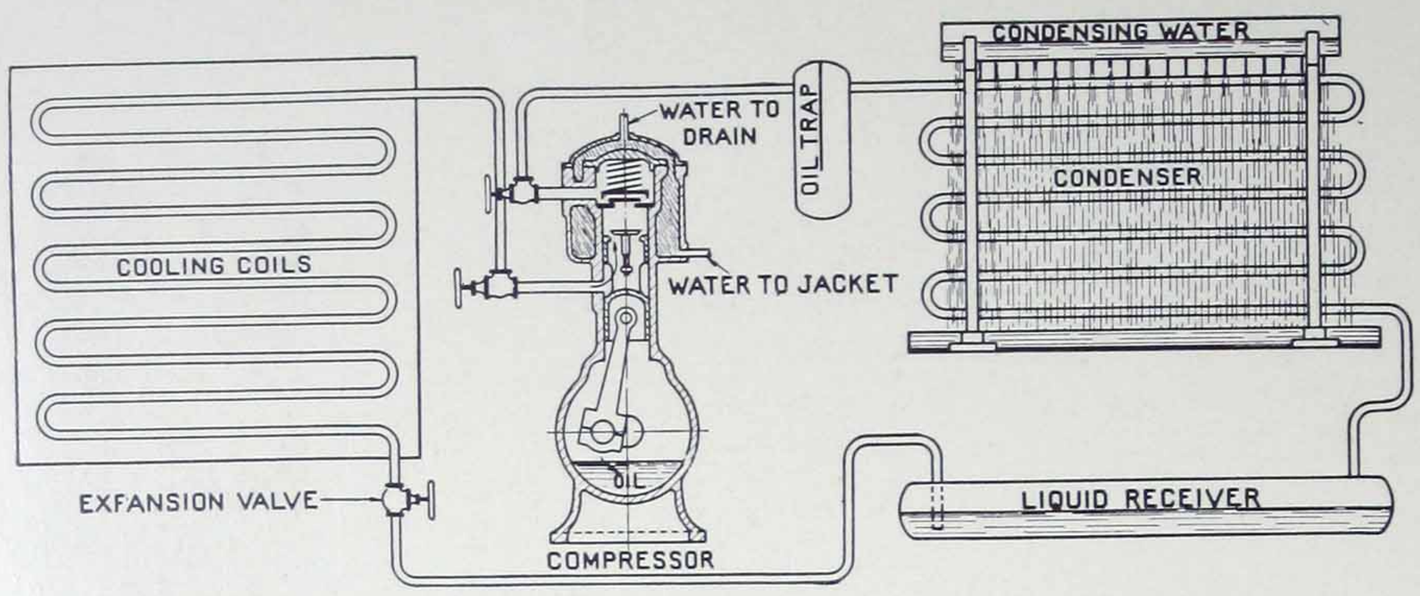
These Frick Ammonia Units provide an excellent example of the adaptability of refrigeration to a great variety of services. Indeed, refrigeration can now be applied in almost as many ways as steam or electricity. Either the ammonia itself, or an intermediate fluid such as brine, cold water, or air, can be piped considerable distances, when required, and "cold" can be used in scores of different ways.

Hardly an application of refrigeration can be named but that Frick ammonia machines are being used in it. On shipboard, in chemical plants, fur storages, and in any of the many processes of the food industry, these units have proved their effectiveness in countless installations.

For experimental and research work, both in laboratories, colleges, government bureaus and similar places, the units are popular because of their uniform performance and ready adaptability to unusual conditions. A manufacturer of ammonia, for instance, operates several of these machines at suction pressures running up to 200 lb. to the square inch—which is approximately 10 times the normal load—without any change being necessary in the machine.



One of the Two 4 x 4 Refrigerating Units With Brine Cooler, Pumps and Piping, in the Million-Dollar Home Economics Building at Cornell University. This Institution Has a Total of 6 Frick Refrigerating Machines



Elementary Diagram of the Refrigerating Cycle, Using the Compression System

Principles of Refrigeration

The essential parts of any Frick refrigerating plant are the compressor, condenser, receiver, expansion valve, and cooling coils: suitable pipe lines, with the necessary shut-off valves, connect one part to another.

The air is pumped out and the system is charged with ammonia—a clear liquid looking like water. While water boils at a temperature of 212 degrees in the open air, ammonia under atmospheric pressure will boil at 28 degrees below zero F. Ammonia has a strong suffocating odor, but is not poisonous and can be used with entire safety in properly made equipment.

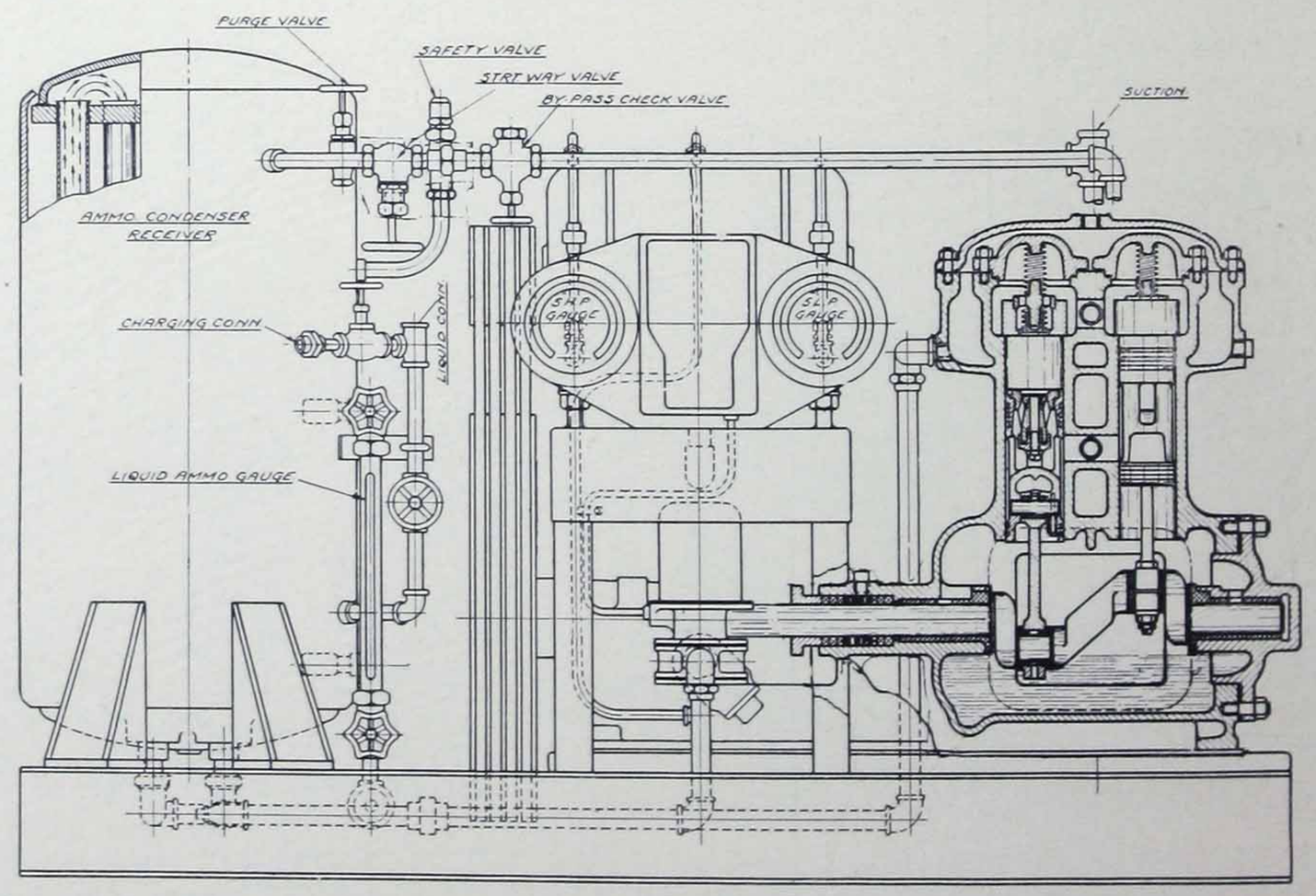
The liquid ammonia is held in the receiver under about 185 pounds gauge pressure, and from there is fed into the cooling coils in a fine stream by means of a regulating or expansion valve. In the same way that boiling water absorbs heat from a fire, and sends it off in the form of the gas we call steam, the liquid ammonia takes up the heat from the pipe coils and evaporates into ammonia gas. By constantly drawing off the gas from the pipe coils, we make them so cold that they chill the air and products around them, and by condensing and freezing part of the moisture in the air, produce the white frost often seen on the pipes.

As fast as the ammonia gas is formed it is drawn into the compressor, which maintains an average, "suction pressure" in the coils of 15 to 25 pounds. The compressor, which is really a gas pump designed for handling ammonia, raises the pressure of the ammonia gas to about 185 pounds again, and forces it into the condenser. The work done on the gas has meanwhile raised its temperature to say 200 degrees F. In the condenser the hot ammonia is cooled by tubes carrying cold water, the effect of which is to change the gas back to liquid form, ready for returning to the receiver and being used again. In the combined unit type of machine the condenser is made large enough to serve also as a receiver.

The power required for driving the compressor is less, in proportion to the cooling effect, if the suction pressure is kept as high as possible (while still producing the cold temperatures desired). By feeding the refrigerant into the bottom of the coils or coolers they can be kept "flooded" with liquid ammonia: flooded operation naturally increases the heat transfer and maintains a high suction pressure. Suitable float valves, automatic expansion valves, and electric control valves are now generally used in place of hand expansion valves, for governing the ammonia feed. Thermostats and special electric controls are similarly used for starting and stopping the compressor automatically, when desired. For efficient operation the head or condensing pressure should of course be kept as low as the use of ample cold water and generous tube surfaces in the condenser will economically allow.

The capacity of a refrigerating machine depends largely upon the number and size of its cylinders, its speed when running, the efficiency of compression, the suction and discharge pressures, and the number of hours of operation per day, the rated capacity being always based on continuous operation through the 24 hours. Machine ratings are usually based on the conditions adopted as standard by the American Society of Refrigerating Engineers, which are 5 deg. F. and 19.6 lb. gauge pressure for the suction, and 86 deg. F. and 154.5 lb. gauge for the discharge.

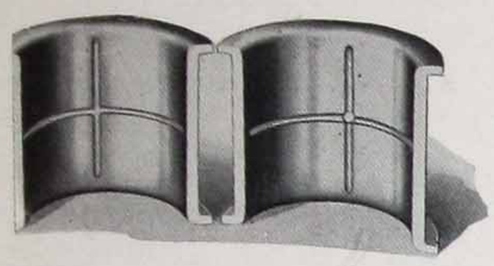
One Ton of Refrigeration is about equal to the cooling effect obtained when a ton of ice, weighing 2000 pounds, is melted in 24 hours. To be exact, 1 T. R. equals 288,000 British thermal units (or B. t. u.) per 24 hours. This is cooling at the rate of 200 B. t. u. per minute. It is usually figured that 1.6 tons of refrigeration are required to make one ton of ice, as the water must first be cooled to the freezing point, and various other losses have to be considered.



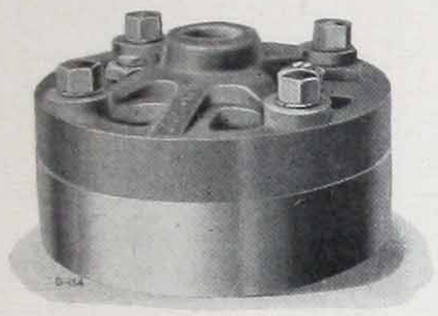
Cross-section View of Frick Combined Ammonia Unit with 2-Cylinder Compressor

Frick Ammonia Refrigerating Units

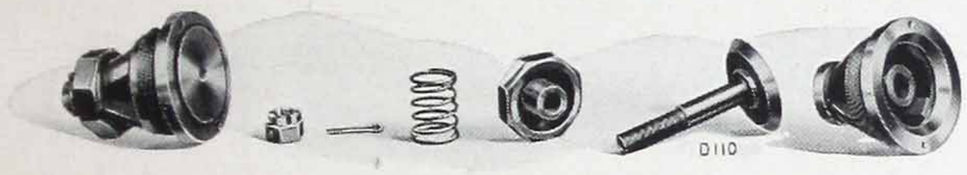
SPECIFICATIONS



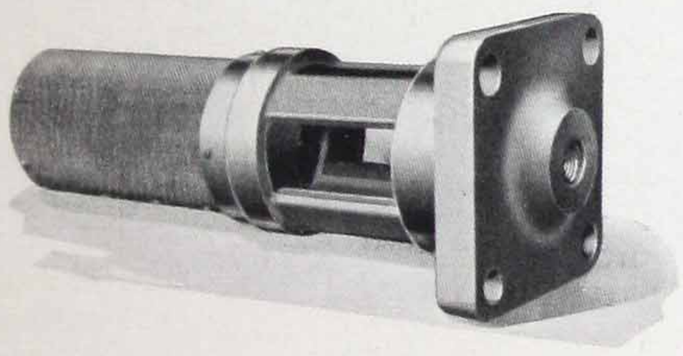
Detail of Die-cast Renewable Bearings, Case-hardened, for Connecting Rod Crank Ends



Safety Cylinder Head

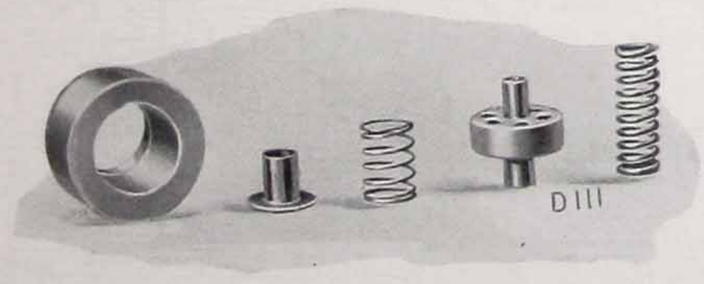


Suction Valve Assembly and Individual Parts



Suction Screen

Plate Type Discharge Valve



Discharge Valve and Safety Head, 3 in. by 3 in. Machines

COMPRESSOR—The compressor is the standard Frick enclosed type, with single-acting cylinders; it has quiet, efficient valves, fully enveloping water jacket, automatic lubrication, renewable bearings, full-size bypass, extra-length stuffing box, and many other superior features, which adapt it especially to heavy service. See details of compressor design on page eleven.

DRIVE—The compressor is operated by electric motor through a V-belt drive. Adjustment of the motor height and tightness of the belts is provided by 4 heavy jack screws, fitted with jamb nuts, on the base plate. The motor is controlled either automatically or by hand; an automatic starter is furnished as standard. Where electric current is not available, the machine can be driven by a flat or V-belt from any source of power.

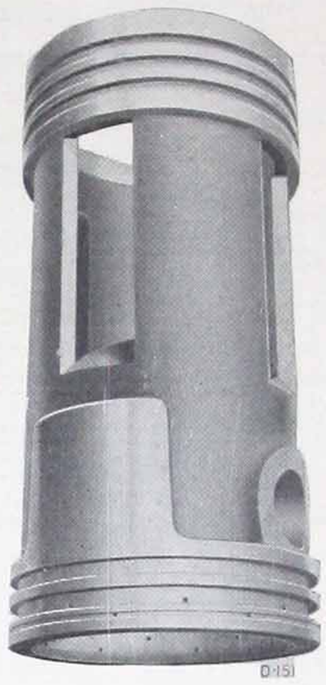
CONDENSER-RECEIVER—This is of the shell type, with straight tubes inside; the cooling water is made to flow through one tube after another, in succession. The water heads are easily removed for cleaning the tubes. The condensed ammonia collects in the base of the shell, which serves as a receiver. The condenser-receiver is completely equipped with gauge glass, and all necessary valves for controlling the flow of ammonia and water: the water regulator is automatically operated by ammonia pressure, and is equipped with a cleanable water strainer.

CRANKSHAFT—The crankshaft is drop-forged from best grade steel, and is heat treated for toughness. Made over-size for rigidity and larger bearing surface.

Dimensions of Frick Combined Ammonia Refrigerating Units

Cylinder Size, Bore & Stroke	No. of Cylinders	Length over Frame	Width over Frame	Width over Belt Wheel	Height above Floor Line	Least Headroom to Withdraw Pistons	Size Ammonia Liquid Connections	Size Ammonia Suct. Connections	Size Water Conn.
3″x3″	1	4′-7½″	23⅞″	22″	3′-9⅝″	4′-4″	⅜″	¾″	¾″
3″x3″	2	5′-8½″	26″	22″	3′-9½″	4′-4″	⅜″	¾″	¾″
4″x4″	2	7′-0½″	30″	30″	5′-3½″	5′-5″	⅜″	1″	1¼″
5″x5″	2	8′-6″	32″	36″	5′-7″	6′-1″	⅜″	1¼″	2″

Dimensions given are not to be used for construction purposes

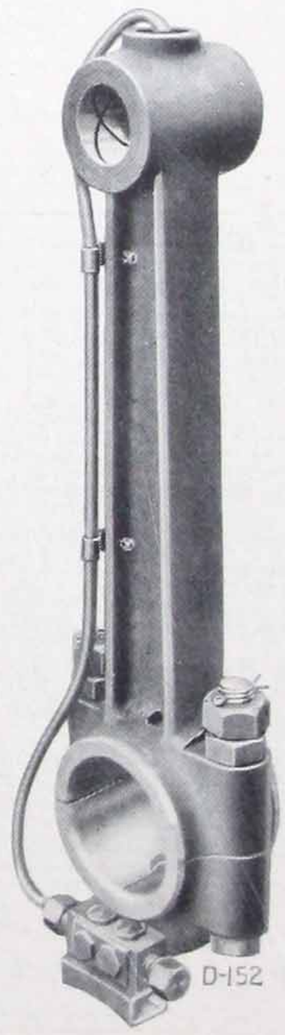


Piston

Oil Scraper Ring

Piston Pin

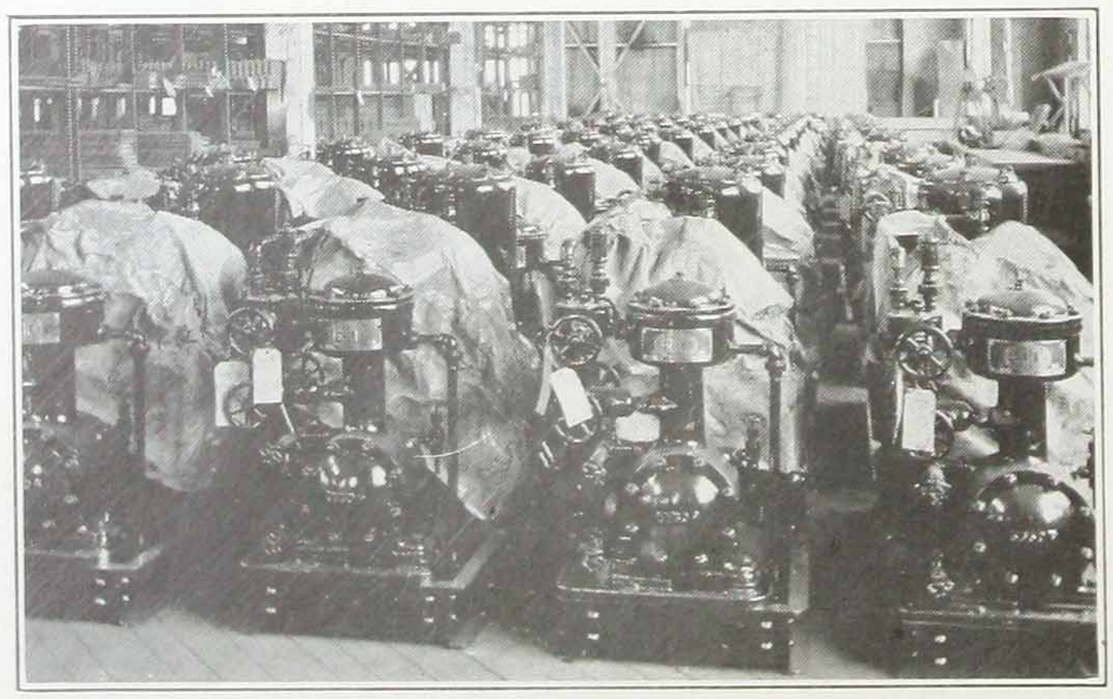
Piston Pin Bearing



Connecting Rod

ICE AND FROST

Frick Combined Ammonia Refrigerating Unit as Built in the 3″ by 3″ One-Cylinder Size



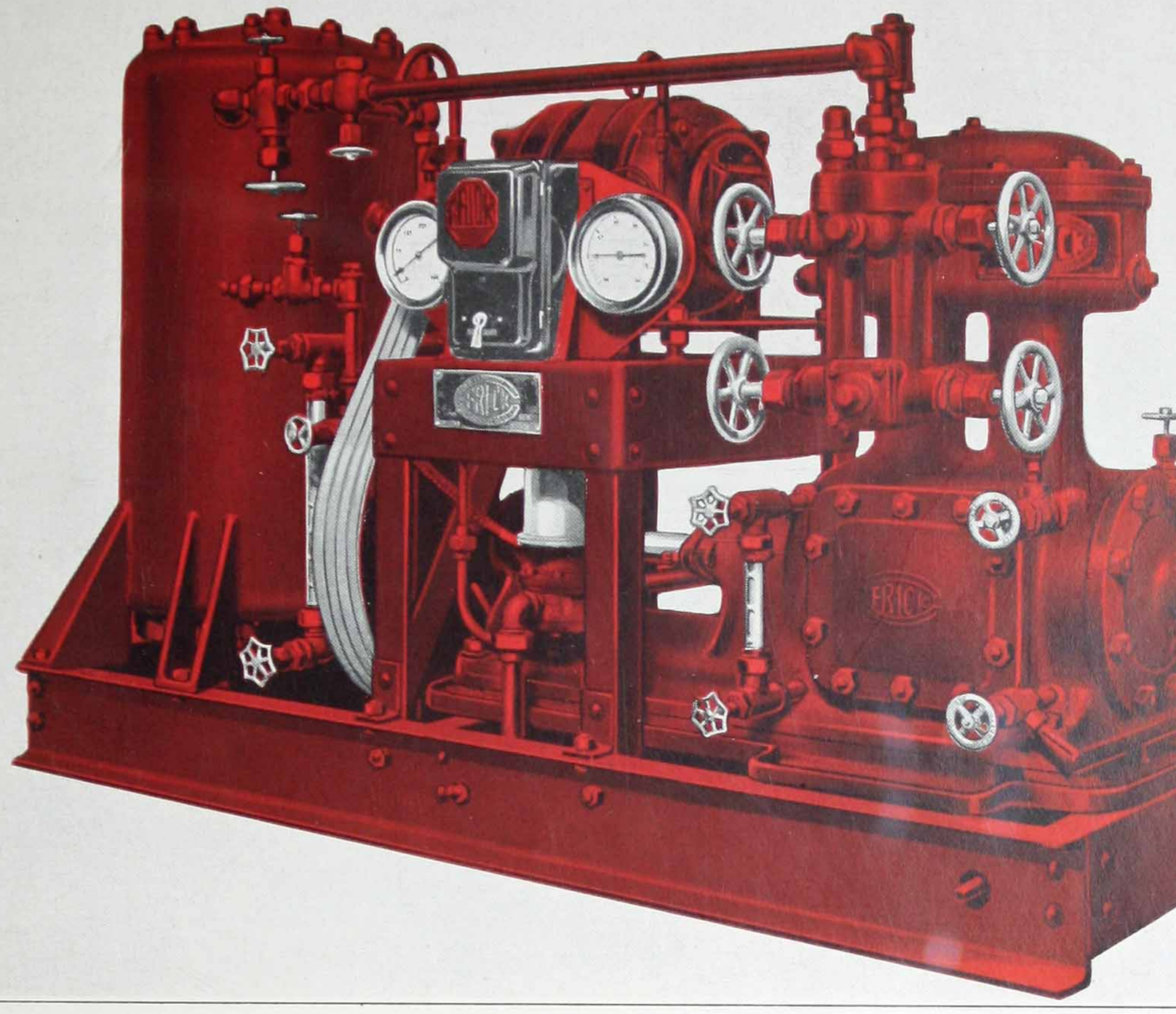
One-cylinder 3″ by 3″ Ammonia Units: Part of the Stock of Frick Combined Refrigerating Units Always Maintained at Waynesboro

SPECIFICATIONS
(Continued)

SAFETY—Safety features include pressure relief valves on the discharge line and condenser-receiver; automatic cut-out intended to stop the motor if the head pressure rises too high; safety cylinder heads held down by springs instead of bolts; self-closing valves on the ammonia liquid and oil gauges, with ball checks which close if the glass is broken; and both overload and undervoltage protection in the motor starter.

COOLING COILS—These are custom built to suit requirements; direct-expansion ammonia or brine coils; tanks for water cooling, ice-making systems, milk cooling, etc., etc.

SIZES—The machines are built as illustrated in 4 sizes: 3-in. by 3-in. one cylinder, 3-in. by 3-in. two cylinder, 4-in. by 4-in. two cylinder, and 5-in. by 5-in. two cylinder. All sizes are of similar construction, and are handsomely finished in wine-color enamel.



Frick Combined Ammonia Refrigerating Unit as Built in the 3″ by 3″ Two-Cylinder Size

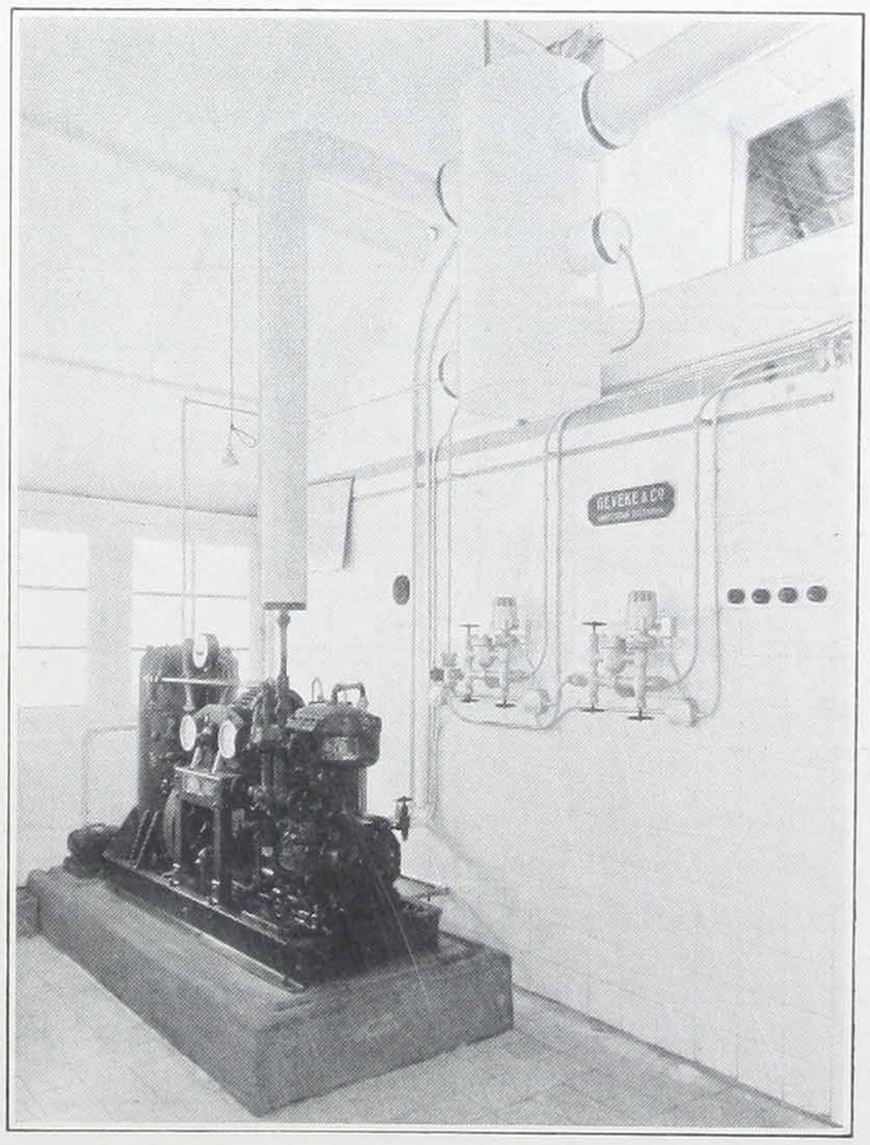
SPECIFICATIONS
(Continued)

DETAILS OF COMPRESSOR DESIGN

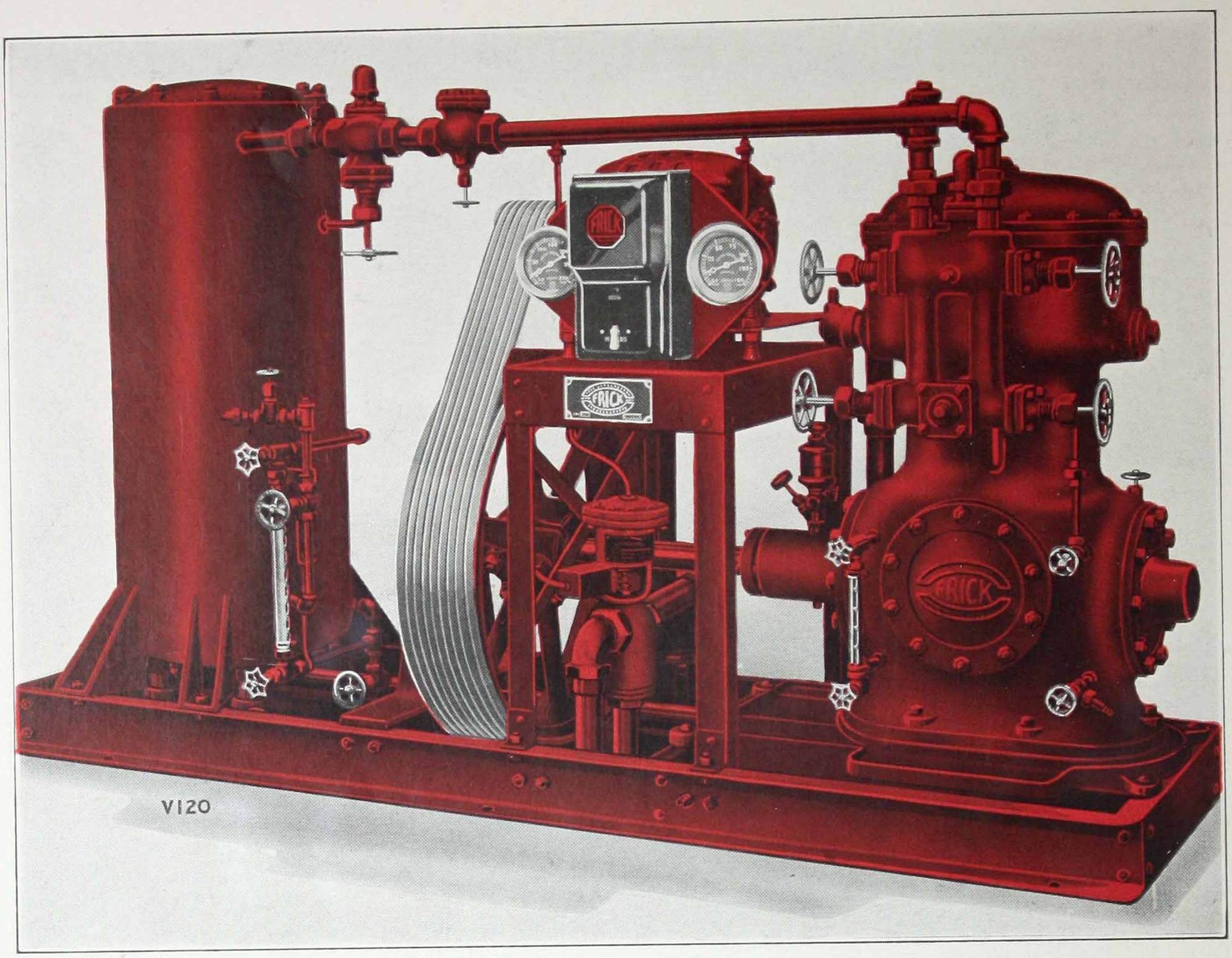
COMPRESSOR FRAME is a one-piece casting, assuring permanent alignment. Special alloy semi-steel, under scientific control, gives metal proper tightness, strength, and hardness for wear resistance. Castings are sand blasted, properly aged, and pressure tested. Honed cylinder walls, extra thick.

WATER JACKET completely surrounds the upper part of the cylinders and covers the cylinder heads, keeping them cool. Jacket cover is removable, so that any mud or scale deposited from the water can be cleaned out.

SAFETY CYLINDER HEADS, held down by heavy springs instead of bolts, lift in case slugs of liquid ammonia enter the cylinders: wasteful clearance space is thus safely eliminated.



Unit Installed in a Market at Bandoeng, Dutch East Indies



Frick Combined Ammonia Refrigerating Unit as Built in the 4″ by 4″ and 5″ by 5″ Sizes

SPECIFICATIONS
(Concluded)

DISCHARGE VALVES are mounted in the safety heads and are either the poppet or plate type, developed especially for this service. (Poppet type on 3″ by 3″ machines.) Light moving parts, quiet, tight and reliable.

SUCTION VALVES are floated by springs and motion is cushioned by dash pots. Entire valve cage is threaded, screwed into the piston and securely pinned. No tap screws to work loose.

PISTONS are unusually long; suction ports uncovered throughout stroke. Ample thrust surfaces opposite piston pins. Pistons are polish ground to accurate size, and are fitted with no less than 5 piston rings.

PISTON PINS are extra large and are made of case-hardened steel, Rockwell tested. Bushings are of cast iron, tightly secured in the rods. Opening through top of bushing admits oil to grooves and pressure surfaces.

CONNECTING RODS of drop-forged steel, made extra long to lessen side thrust on pistons, Crank bearings are of marine type, with shims for adjustment. Chrome-vanadium steel bolts, secured by lock nuts and pins, used on crank end. H-section connecting rod gives stiffness and strength.

CRANKSHAFT is drop-forged from best grade steel, and is heat treated for toughness. Made over-size for rigidity and larger bearing surface.

STUFFING BOX is made double length, with self-adjusting spring serving also as oil lantern—holds pressure with gland nuts only finger tight. Shaft runs in oil.

DIE-CAST BEARINGS, of best grade heavy-duty babbitt, surface hardened for longest wear. Bearings are interchangeable.

BYPASS CONNECTIONS are full size, made in a one-piece manifold. Frick patented tight closing control valves arranged in simple square pattern, with safety relief valve above and suction screen below. Scale trap easily accessible for cleaning.

STANDARD EQUIPMENT supplied includes; two ammonia gauges on metal board, packing for stuffing box, set of wrenches and tools, foundation bolts and wedges, hose for drawing in oil, enameled instruction chart, piston ring guide, erecting drawings, etc.

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CCA

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Boston, Massachusetts	716 Columbus Avenue
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Pittsburgh, Pennsylvania	1005 Liberty Avenue
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Seattle, Washington	312 Columbia Street

Frick Sales Representatives

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Chicago, Illinois	Midwest Engineering & Equipment Co., 617 Fulton Street
Detroit, Michigan	Detroit Ice Machine Company, 2615 Twelfth Street

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